CHARLES RIVER STUDY

COORDINATING COMMITTEE MEETING

5 March 1969

POLLUTION & SEWERAGE - TREATMENT STUDIES

by

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Since the last Coordinating Committee Meeting, we have established a mathematical model of the Upper and Middle Charles River which indicates the river's dissolved oxygen response to variations in waste loadings and quantities of streamflow. As stated at the last meeting, this model will be the basis for determining future requirements for flow augmentation or other pollution control measures.

At the present time, I cannot present any specific recommendations for future flow augmentation or other measures for the entire river. However, we have analyzed in some detail future flow requirements and degree of waste treatment relationships for the headwaters of the Charles and the Milford municipal waste treatment facility. I plan to present some of these results, which will point out the methodology we will use in analyzing the entire river.

First of all, estimates of the future population of each community and the future population served by the sewerage system in each of the Upper Charles communities are shown on Plate 1. As you can see, by 2020 the population of the Upper Charles River communities will increase substantially. The Milford sewerage system serves approximately 12,000 persons at the present time. By 2020, the projected figure will be 36,000 persons.

Plate 2 shows the sewage flows contributed by the communities for the projected years. By 2020 the total sewage flow from these towns is expected to be about 70 cfs as compared to 7.5 cfs in 1965. The quantity of sewage contributed by Milford in 1965 was 2.4 cfs and by 2020 is expected to increase to 9.0 cfs.

From these graphs it is obvious that in the future a higher degree of treatment than secondary treatment, that which removes about 85%

of the deoxygenating wastes will be necessary to meet water quality standards. And because of the large volumes of waste flow in relation to the summer low flows (between 12 and 20 cfs at the Charles River Village gage), in future years municipalities will be required to aerate their effluents to provide adequate dissolved oxygen concentrations before discharge to the river.

In our analyses of the flow requirements at the headwaters of the Charles River, we have assumed that by 1980, Milford will be required, as a minimum, to provide a type of treatment known as coagulation and sedimentation in addition to secondary treatment during the critical summer months. This treatment removes about 90% of the deoxygenating wastes and also about 90% of the total phosphate, which is one of the nutrients necessary in algal production. When phosphate concentrations are excessive nuisance algal blooms may result.

With no additional treatment above sedimentation and coagulation in 2020, approximately 45 cfs of dilution water will be required during the critical months of July and August to maintain dissolved oxygen standards. And conversely with no flow augmentation, to meet desired levels of water quality in 2020 approximately 98% of the deoxygenating wastes with aeration to 6 mg/l will be necessary at an annual cost above the minimum required treatment of $109,000 per year over fifty years. The following view graph (Plate 3) shows the variation in cost of additional treatment versus dilution flow provided. As more dilution is provided, the cost of treatment decreases.

With a knowledge of augmentation flows needed for different levels of treatment, the volume of storage required to meet these needs can be computed. We will then ask the Corps or other interested agencies to furnish us the average annual costs of providing various volumes of storage whether the storage be supplied from within the watershed or be obtained from another watershed. By plotting costs of storage and costs of treatment per level of storage, we can determine the least cost combination. Plate 4 will serve as an example. The curves which were developed for a stream other than the Charles River are plots of the average annual cost of treatment needed at different levels of storage and the average annual costs of storage. By summing the treatment costs and storage costs, a curve is established that will give the combined average annual cost of treatment and storage. There is an optimum combination of storage plus treatment, the minimum point on the curve. The storage at the optimum point would be the recommended storage from strictly a dollar cost point of view. Of course in the plan formulation further evaluations will have to be made of the social or intangible costs - the gains and losses associated with alternative combinations of treatment and storage including those associated with specific storage sites.

This is the type of analyses that we will be performing on the entire Charles. Any flow provided at Milford may benefit other reaches of the stream, and therefore, the costs of treatment of waste from other municipalities will have to be added to the cost of treating Milford's wastes.

Another alternative we will investigate is the feasibility of transporting a portion of or all wastes to the MDC system. The cost of transferring wastes out of the watershed will be compared with the cost of the optimum combination of treatment and storage.

In conclusion, I feel that by June of 1969, we can come up with some firm recommendations of storage requirements.

PLATE I

PROJECTED POPULATION

OF UPPER CHARLES RIVER WATERSHED COMMUNITIES

Community	1965		1980		2000		2020	
	Pop.	Pop. Served	Pop.	Pop. Served	Pop.	Pop. Served	Pop.	Pop. Served
Bellingham (50%)	5,300	0	9,000	2,700	14,000	7,000	18,500	13,000
Dover	3,600	0	6,500	0	11,500	3,400	17,500	7,000
Franklin	14,700	4,500	22,000	8,800	41,000	20,500	60,000	48,000
Holliston	8,900	0	15,000	4,500	24,000	9,600	35,000	21,000
Medfield	7,500	1,000	12,000	3,600	28,000	19,600	38,000	34,200
Medway	6,900	200	10,000	3,000	15,000	6,000	19,000	11,400
Milford	17,000	12,000	22,000	17,600	29,000	26,000	36,000	36,000
Millis	5,300	1,000	9,000	2,700	18,000	9,000	26,000	20,800
Norfolk	4,000	0	7,000	700	13,000	3,900	22,500	11,200
Sherborn	2,300	0	7,000	0	19,000	7,600	32,000	22,400
Wrentham	7,500	0	13,000	2,600	36,000	21,600	48,000	38,400
Total	83,000	18,700 (22%)	132,500	46,200 (35%)	248,500	134,200 (54%)	352,500	263,400 (75%)

PROJECTED WASTE FLOWS

OF UPPER CHARLES RIVER WATERSHED COMMUNITIES

Community	Location of Waste Discharge (River Mile)	1965 Waste Flow (cfs)	1980 Waste Flow (cfs)	2000 Waste Flow (cfs)	2020 Waste Flow (cfs)
Milford	73.4	2.4	3.1	5.6	9.0
Bellingham	69.1	0.0	0.4	1.4	3.0
Franklin	63.2-3.4	2.2	3.1	7.0	14.7
Medway	58.7	0.3	0.4	1.2	2.5
Wrentham	59.6-3.4	0.0	0.6	5.6	11.6
Norfolk	51.8-3.4	1.1	1.2	2.0	4.1
Millis	49.8-1.1	1.0	1.2	2.8	6.2
Medfield	49.2-1.9	0.5	1.0	4.6	8.8
Holliston	48.4-6.0	0.0	0.8	1.8	4.6
Sherborn	47.0-2.5	0.0	0.0	1.7	6.0
Total		7.5	11.8	33.7	70.5

PLATE 2

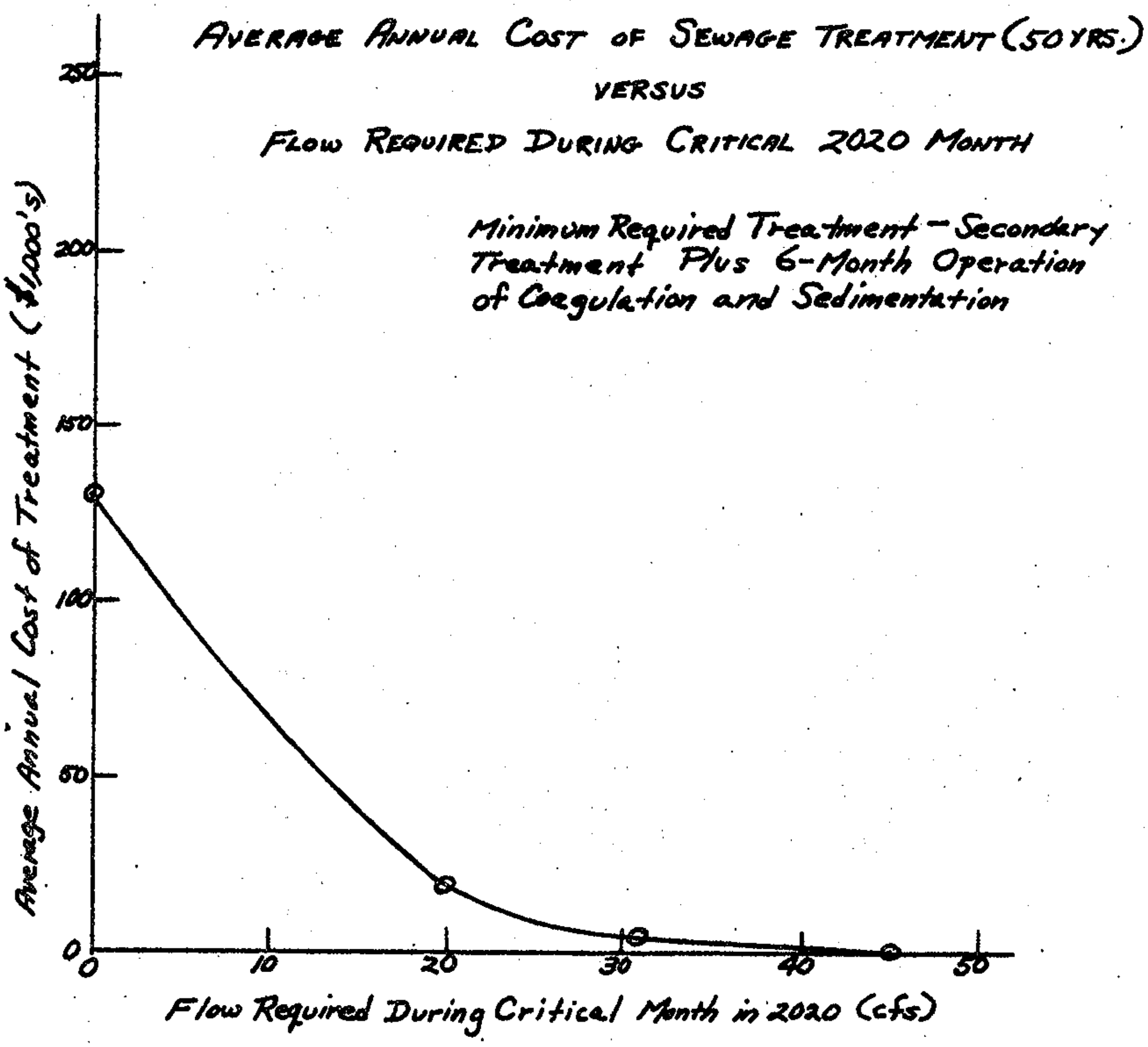
AVERAGE ANNUAL COST OF SEWAGE TREATMENT (50 YRS.)
VERSUS
FLOW REQUIRED DURING CRITICAL 2020 MONTH
Minimum Required Treatment – Secondary Treatment Plus 6-Month Operation of Coagulation and Sedimentation
Average Annual Cost of Treatment ($1,000's)
250
200
150
100
50
0
0
10
20
30
40
50
Flow Required During Critical Month in 2020 (cfs)

PLATE 3

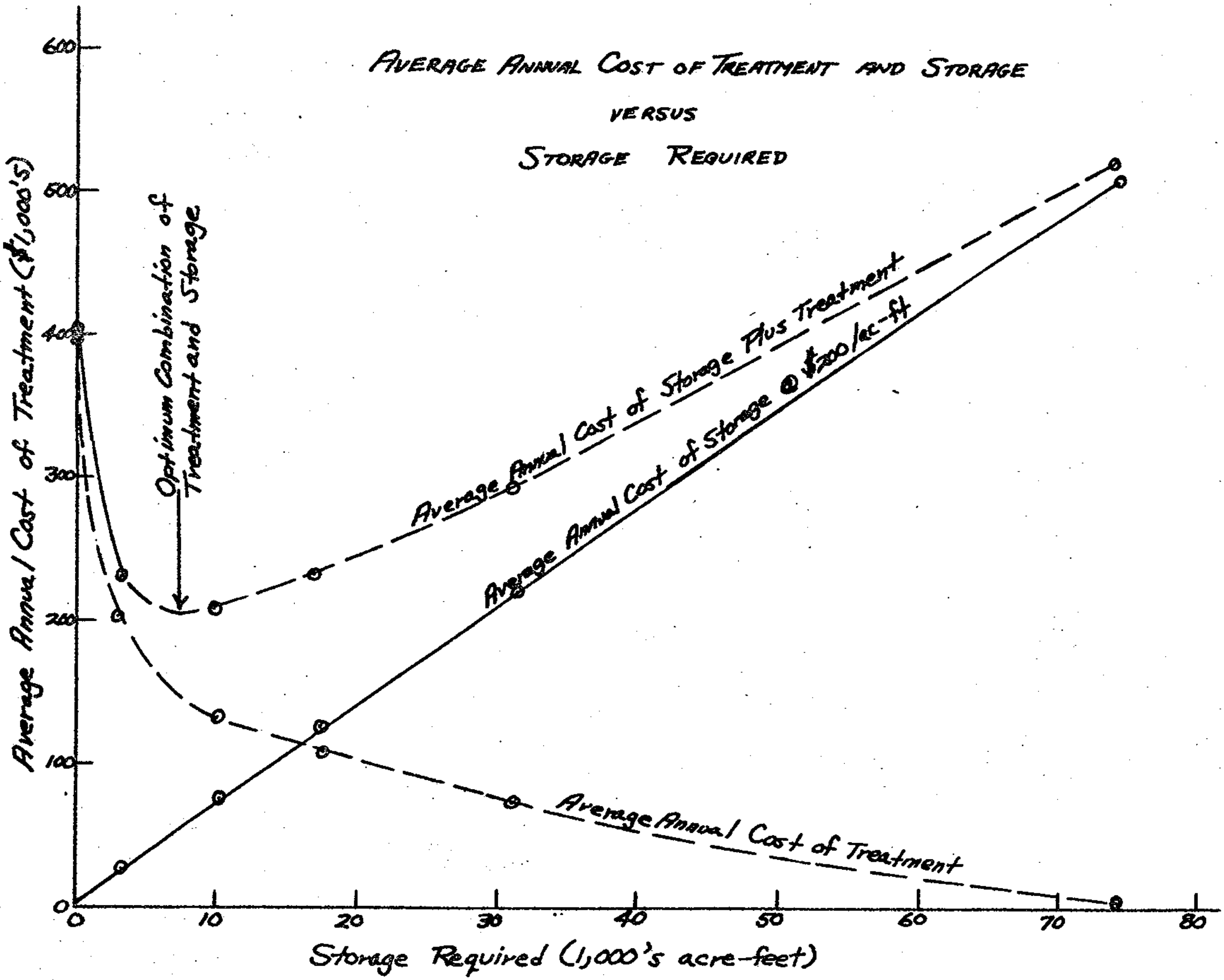
AVERAGE ANNUAL COST OF TREATMENT AND STORAGE
VERSUS
STORAGE REQUIRED
Average Annual Cost of Treatment ($1,000's)
Storage Required (1,000's acre-feet)
Optimum Combination of Treatment and Storage
Average Annual Cost of Storage Plus Treatment
Average Annual Cost of Storage @ $200/ac-ft
Average Annual Cost of Treatment
0
100
200
300
400
500
600
0
10
20
30
40
50
60
70
80

PLATE 4